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# The Extract of *Moringa* Leaf Has an Equivalent Effect to Iron Folic Acid in Increasing Hemoglobin Levels of Pregnant Women: A randomized Control Study in the Coastal Area of Makassar

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**Abstract**

Moringa is a tropical plant that is often found in South Sulawesi, but the use is still limited as a vegetable. Moringa leaf contain a number of nutrients such as protein, iron and vitamin C potentially to prevent anemia were more common in pregnant women. This study aimed to determine the effect of Moringa leaf extract for anemia prevention in pregnant women. This study used a *Randomized Double Blind* design, *Pretest-Posttest controlled* by using a sample of non-anemic pregnant women. Hemoglobin (Hb) level was measured by cyanment hemoglobin method using a hemocue. Hb levels of pregnant women in a group of moringa leaf extract before intervention (11 283 ± 0777 g/dL) increased to 11 754 ± 1089 g/dL after intervention (p = 0.040). Hb levels of pregnant women in folic iron group also increased between before and after intervention (p = 0.002). The amount of increase in hemoglobin concentration of pregnant women in folic iron group of 0.9886 ± 1.7638 g/dL) higher than moringa leaf extract group (0.4771 ± 1.3051 g/dL), but a large increase in hemoglobin levels between the two groups was not significant (p = 0168).

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Moringa leaf extract can improve hemoglobin levels and have equal ability with iron supplements of folic acid in preventing anemia in pregnant women. Moringa leaf extract can be used as an alternative to prevention of anemia in pregnant women.

***Keywords:*** Pregnant women; *Moringa* leaf extract; Anemia.

**1. Introduction**

Nutrient deficiency is a public health problem that is often found in pregnant women in Indonesia, thus increasing the risk of morbidity and mortality in mothers and infants. Maternal mortality rate in 2007 was 228 per 100,000 live births, still two times more than MDG's target by 2015 in the amount of 102 per 100,000 live births [1]. A factor that contributes to the high rate of maternal mortality is due to deficiency of micronutrients. Pregnant women who are anemic at greater risk for morbidity and perinatal mortality [2]. Micronutrient deficiency problems that are often found in pregnant women are iron deficient. Iron deficiency is the most common nutritional problems found throughout the world, which causes iron deficiency anemia in 500 to 600 million people [3]. Based on Health Research in 2013, the prevalence of anemia in pregnant women in Indonesia reached 37.1% [4], and in South Sulawesi is 46.7% [5]. Iron deficiency has been known not only cause anemia in pregnant women. Iron substances usually interact with other micro nutrients in the body, such as zinc (Zn) and vitamin C. In pregnant women with anemia was also found to have deficiencies of micronutrients such as Zn and folic acid [6].

In coastal communities and urban suburban areas often encountered poor environmental health conditions, the low level of education and lack of awareness about healthy lifestyle, as well as low levels of family economy. In poor societies or low-income families, people's ability to maintain and improve the health status are also low so the impact on the nutritional status and public health, especially mothers and children health. Pregnant women are one of vulnerable groups to the nutritional problems. Based on [7] research showed a housewife who suffered with Chronic Energy Deficiency (CED) during pregnancy of 40.5% and BMI below normal of 16.2%. The rate of anemia in pregnant women who worked as a housewife in this city reached 32.4%.

To improve the nutritional status of pregnant women need macro- and micro-nutritional interventions to pregnant women. Macronutrient can be done with awareness through nutrition education to meet their nutritional needs, while micronutrients can be met by giving formula or multi-micronutrient supplementation.

The program of anemia prevention in pregnant women in Indonesia has been implemented through folic iron tablets, but the problem of anemia in pregnant women still cannot be resolved. This is due to the anemic problem in pregnant women in developing countries is not only caused by an iron deficiency, but dealing with the problems of other micronutrients such as zinc deficiency, vitamin C, vitamin E. Therefore, prevention of anemia in pregnant women should be integrated with the prevention of other micro-nutrients by exploiting the potential of local resources, making it easy to reach by public and continuous. One of the potential for local food rich in micronutrients and are widely available but not fully utilized is Moringa leaf (*Moringa oleifera*). Moringa plant is easily found in all parts of Indonesia, including in South Sulawesi.

Fuglie in a study of malnutrition communities in Senegal Africa reported that treatment of Moringa leaf powder can improve the nutritional status of individuals significantly [8]. Therefore, moringa can be used as an additional food source in an attempt to treat malnutrition. Moringa leaf have the potential for large enough nutrients, contains a number of amino acids, and essential micronutrients, such as vitamin A, vitamin C, vitamin E, iron, calcium, zinc and selenium [9]. The results of study by [10] showed that administering of Moringa leaf powder for 3 months can significantly improve hemoglobin concentration, although its impact has not been able to match the control that received iron-folic tablets.

Based on these problems it is necessary to do research on the effect of Moringa leaf extract for anemia prevention in pregnant women.

## 2. Research Methods

### *2.1 Research Design*

This research will be carried out experimentally by using *Randomized Double Blind*, *Pretest-Posttest Controlled*. Pregnant women who meet the criteria (age 5-6 months of pregnancy, hemoglobin (Hb) > 10.5 g/dL, and worked as a housewife) divided into two groups by *simple random sampling*. The first group received the intervention of Moringa leaf extract and the second received supplementation of folic iron (60 mg Fe and 0.25 mg folic). Intervention performed during 12 weeks. Before and after intervention performed hemoglobin (Hb) level measurement.

The research was conducted in the coastal areas of Makassar, South Sulawesi Province, Ujung Tanah subdistrict, Tallo, Mariso and Tamalate. Total sample of 35 people per group.

### *2.2 Making Moringa Leaf Extract*

Making moringa leaf extract capsules made in the Micronutrient laboratory of Nutrition and Food Studies Center (PSGP) Hasanuddin University, Makassar. Moringa leaf are selected in this study were drawn from growing Moringa plant in Makassar city and surrounding areas, have fertile leaf, fresh and mature leaf are dark green.

Moringa leaf are picked and then washed by dipping into the water and douse with flowed water several times. Once washed and dried by aerate for 2 hours, then threshed in order to separate them from the stem. Furthermore, it is dried using a heating of incandescent lamps with temperature 38 - 39$^{o}$C for 2 x 24 hours or until the sample appears dry. The dried leaves and then kneaded by hand (shielded) to small-shaped. Subsequently, the dried Moringa leaf macerated with ethanol (70%) for 1 x 24 hours. This treatment was repeated for 3 times. The result is then filtered to separate extract and its slag. Moringa leaf extract then rotavored at $60^{0}$ C for 2 x 24 hours. Encapsulation process performed by mixing 800 mg of Moringa extract with Moringa powder of 200 grams for each capsule.

### *2.3 Data Collection, Processing and Analysis*

Hb measurements to be conducted by using Cyanmenhemoglobin method using *Hemocue*, using peripheral blood. Data processing and analysis using SPSS for windows. Analysis using statistical t-test two samples relates to examine differences between Hb level before and after intervention, and t-test two independent samples to analyze differences in changes in Hb levels between groups.

### *2.4 Ethical Approval*

The research was conducted after obtaining approval from the Ethics Committee of Medical Faculty, Hasanuddin University.

## 3. Result of research

### *3.1 Characteristics of subjects*

Table 1 shows the majority of pregnant women in both groups were aged between 20-35 years (92.9%), had a gestational age of 20-23 months (55.7%), and present pregnancy interval with before that most are > 4 years.

Pregnant women in both groups generally have experience pregnant (gravida) > 3 times (50%), more has never given birth (28.6%), and had children between 1 - 2 children (48.2%). Statistical analysis showed no significant differences in the characteristics and history of pregnancy ($p > 0.05$). That is, the two groups of this research have equality or similarity, especially in age, gestational age, spacing with previous birth, pregnant frequency (gravida), delivery frequency (parity) and number of children.

### *3.2 Hemoglobin Level*

Table 2 shows that the levels of hemoglobin (Hb) both study groups experienced significant improvement after the intervention ($p < 0.05$). Increased levels of hemoglobin in the control group 2 times more than the intervention group. However, the amount of increase in hemoglobin levels between the two groups did not differ significantly ($p > 0.05$).

### *3.3 Anemia Status*

Graph 1 shows, after the intervention there are about 18.6% of pregnant women are anemic. The proportion of pregnant women suffer from anemia is more common in the intervention group (22.9%), whereas in the control group only 14.3%. Nevertheless, based on the statistical test showed no difference in the proportion of patients anemia after intervention between the intervention group and control group ($p = 0.270$).

## 4. Discussions

The gestation period is a period that is very prone to anemia. Needs the nutrients essential for the formation of hemoglobin (Hb) as iron increases during pregnancy, so that the use of iron stores in the body will increase. This

happens because the iron intake of pregnant women everyday does not meet the increase needs due to the pregnancy process. In addition, the lack of nutrients intake which helps iron absorption such as vitamin C, is one of the elements that will determine the incidence of anemia in pregnant women.

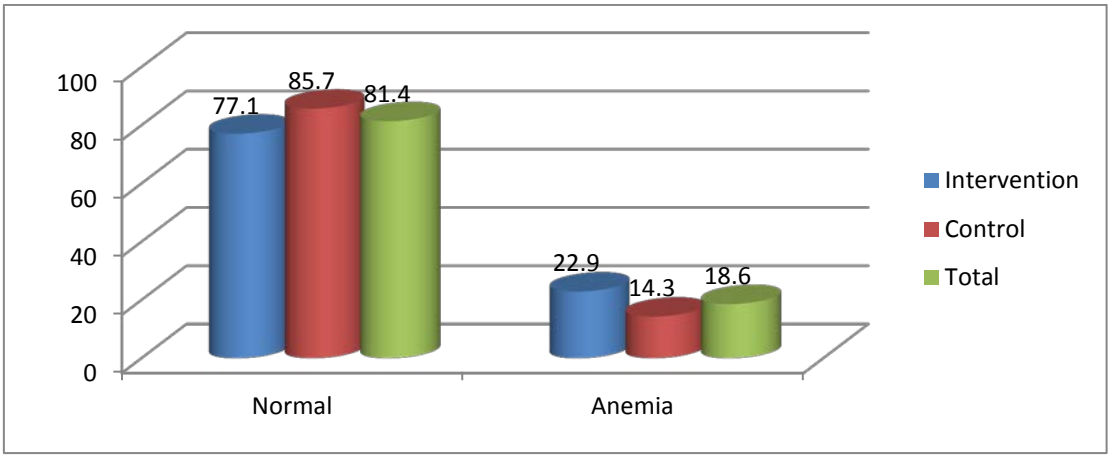
An efforts made to prevent anemia in pregnant women is utilizing local potential. One of the local potential is widely available in South Sulawesi is Moringa leaf. It contains iron and vitamin C which is quite high. In this study, Moringa is made in extracts form and then packaged as capsules, making it easier to consume and more secure and durable.

**Table 1:** The state of pregnancy

| Variables | Intervention | | Control | | Total | | p-value |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Age: | | | | | | | |
| < 20 year | 2 | 5.7 | 1 | 2.9 | 3 | 4.3 | |
| 20-35 year | 31 | 88.6 | 34 | 97.1 | 65 | 92.9 | 0.291 |
| >35 year | 2 | 5.7 | 0 | 0 | 2 | 2.9 | |
| Gestational age | | | | | | | |
| 20-23 month | 21 | 60.0 | 18 | 51.4 | 39 | 55.7 | 0.315 |
| 24-26 month | 14 | 40.0 | 17 | 48.6 | 31 | 44.3 | |
| Birth spacing: | | | | | | | |
| <12 month | 2 | 6.7 | 2 | 7.7 | 4 | 7.1 | |
| 12-23 month | 6 | 20.0 | 2 | 7.7 | 8 | 14.3 | |
| 24-35 month | 6 | 20.0 | 8 | 30.8 | 14 | 25.0 | 0.501 |
| 36-47 month | 2 | 6.7 | 4 | 15.4 | 6 | 10.7 | |
| ≥48 month | 14 | 46.7 | 10 | 38.5 | 24 | 42.9 | |
| Gravida: | | | | | | | |
| 1 times | 5 | 14.3 | 12 | 34.3 | 17 | 24.3 | 0.133 |
| 2 times | 11 | 31.4 | 7 | 20.0 | 18 | 25.7 | |
| ≥3 times | 19 | 50.3 | 16 | 45.7 | 35 | 50.0 | |
| Parity: | | | | | | | |
| 0 | 9 | 25.7 | 11 | 31.4 | 20 | 28.6 | |
| 1 | 8 | 22.9 | 8 | 22.9 | 16 | 22.9 | 0.342 |
| 2 | 7 | 20.0 | 11 | 31.4 | 18 | 25.7 | |
| ≥3 | 11 | 31.4 | 5 | 14.3 | 16 | 22.9 | |
| Number of children: | | | | | | | |
| 0 children | 9 | 25.7 | 10 | 28.6 | 19 | 27.1 | 19 | 27.1 | 0.136 |
| 1-2 children | 14 | 40.0 | 20 | 57.1 | 34 | 48.6 | 34 | 48.6 | |
| >2 Children | 12 | 34.3 | 5 | 14.3 | 17 | 24.3 | 17 | 24.3 | |

**Table 2**: Comparison of hemoglobin levels between before and after intervention for each supplementation group

| Group | Before | After | p | Δ (T3 – T0) X ± SD | p-value |
|---|---|---|---|---|---|
| Intervention | 11.28±0.78 | 11.75±1.09 | 0.040 | 0.47±1.31 | 0.168 |
| Control | 11.28±0.86 | 12.27±1.53 | 0.003 | 0.99±1.76 | |




**Graph 1**: Comparison of anemia proportion (%) between groups after intervention

Intervention in extract form of Moringa leaf and folic iron may increase maternal hemoglobin concentration. Hb levels of pregnant women in the intervention group consumed Moringa extract experienced an increase of 0.4771 g/dL. The result of statistical analysis (two-sample paired t-test) showed there is a difference significantly between maternal hemoglobin concentration before after Moringa leaf extract intervention ($p = 0.040$). These results are consistent with the results of research conducted by Nicholas EAD in his study of breast feed mothers [10]. Moringa leaf powder for 3 months can increase the Hb concentration significantly for breast feed mothers, although the impact has not been able to match the control that received folic-iron tablets. This study also showed that Moringa extract can increase maternal hemoglobin concentration although the increase is not as large as in the control group who consumed iron-folic acid. Moringa extract proven to prevent anemia in pregnant women, although there are still about 22.9% were anemic after the intervention. Control group of pregnant women who consume folic iron are still found with anemia (14.3%). Statistical analysis showed no difference in the number of patients with anemia between the two intervention groups ($p = 0.270$). That is, Moringa extract has the ability equivalent to an folic-iron in preventing anemia in pregnant women.

The research conducted by [11] in Gowa district reported that the administering of Moringa leaf extracts can improve maternal hemoglobin concentration. Similar findings were also reported by [12] on pregnant women informal workers in Makassar concluded that the administering of Moringa leaf extract may improve maternal

hemoglobin concentration. However, in both these studies Moringa extract combined with iron folic acid and most of research subjects were pregnant women are anemic.

Chandra Bhusan niraj and Harsh Bijay Vardhan reported that in animals that were fed Moringa leaf for 7, 15, 30, 45 and 60 days, found a linear increase *Total Erythrocyte Count* (TEC). Increased values of TEC were found statistically significant from the beginning to the end of experiment [13]. Ghebereselassie reported that the administering of Moringa leaf as much as 600 mg/day for 30 days increases about 30% of erythrocytes [14].

Moringa leaf have the potential for large enough nutrients, amino acids and contains a wide range of micronutrients, especially iron is quite high at 28.29 mg. Besides, it also contains a number of important nutrients to help the iron absorption in the body such as vitamin C is 220 mg [8, 9]. The content of vitamin C in Moringa leaf extract expedite the process of iron absorption [15]. Based on the results of laboratory tests are known nutrient composition of Moringa leaf extract South Sulawesi variety; 25.25% of protein, 91.72 mg of iron, 33991.51 ug of vitamin A, 1125.71 mg of vitamin C and vitamin E 3.34% per 100 grams matter. According to [16] dried Moringa leafs contain 773 mg of vitamin C per 100 grams of dry matter.

Vitamin C is a very important element to improve the absorption of iron. Ascorbic acid can prevent the negative effects of various inhibitors such as phytate and polifonol [17]. Vitamin C plays a role in helping to reduce the iron mainly in the form of non-hem iron dissolved form, from ferry into ferrous [15, 18].

Hb-level in pregnant women who consume folic iron also increased significantly. It increases from before intervention of 11.277 g/dL to 12.265 g/ dL after intervention. The results of statistical tests showed there is a difference significantly in Hb-level between pregnant mother before and after intervention ($p = 0.002$). Increased Hb-level in pregnant women in the control group two times higher than the intervention group, which reached 0.9886 g/ dL. Increasing hemoglobin-levels in the intervention group only reached 0.4771 g/dL. Although the value of changes in hemoglobin levels higher, but these difference is not significant. This condition shows that Moringa leaf extract has equivalent effectiveness with folic iron in prevent anemia in pregnant women.

The effectiveness of folic-iron in anemia prevention in pregnant women has been many published. However, in this study there are 14.3% of pregnant women who consume folic-iron anemic, although classified as mild anemia. This is presumably due to the lack of compliance of pregnant women in consuming these supplements. Folic iron should be consumed every day, but for some reason forgot and no unpleasant taste and cause nausea, causing pregnant women become irregular to consume these supplements. In addition, anemia is not only caused by iron deficiency alone but can also be caused by infection, and as a result of the pregnancy itself that caused the dilution of red blood cells (hemodilution).

## 4. Conclusions and Recommendations

Moringa leaf extract can improve hemoglobin levels and have equal ability with iron supplements of folic acid in preventing anemia in pregnant women. It can be used as an alternative to prevention of anemia in pregnant women.

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